
Books

A Handbook of Lattice Spacings and Structures of Metals and Alloys. By W. B. Pearson. NRC No. 4303. 1044 pp. Pergamon Press, London & New York, 1958. \$38.00. *Reviewed by George H. Vineyard, Brookhaven National Laboratory.*

Metallurgists and solid-state physicists should take delight in this book, which is a monumental compilation of x-ray structural data. It treats all the pure metals and metalloids, all the binary and ternary alloys that have been examined, a large number of quaternary and higher alloys, and the metal hydrides, borides, carbides, oxides, and nitrides. The lattice spacings, structures, and atomic coordinates are given in a coverage of the literature that is essentially exhaustive. The principal part of the book, in which this data is assembled, contains no less than 790 pages, and includes information on approximately 2000 alloy systems (as determined by the reviewer's sampling techniques). This is a staggering number, although it is humbling to realize that out of some 78 elements that are metallic or semi-metallic, 3003 binary and 76 076 ternary alloy systems can be formed, and thus the great majority of possible alloys have not yet been the subjects of structural investigations at all.

Five introductory chapters set the stage for the great mass of data to follow. A discussion of precision x-ray methods for determining lattice spacings and for examining equilibrium diagrams in alloys is presented first. There is some good practical advice here and a distillation of much wisdom, although the reader who desires to know just how the experiments are performed will have to look elsewhere. A very concise discussion of the theory of alloys, largely along lines associated with the name of Hume-Rothery, is then given with emphasis on lattice spacings and atomic diameters. The relations between lattice spacings and magnetic properties, insofar as these can be discerned, and the influence of temperature, quenching, order, particle size, and other miscellaneous factors on lattice spacing are cursorily discussed. These sections are provocative and of broad scope, but because of their brevity, they are essentially guides to the literature rather than thorough treatments.

A large part of the information in this handbook is also to be found in the multivolume series *Strukturbericht* and *Structure Reports*, but has not previously been available in concise form. The book is designed to be used in conjunction with the *International Tables for X-Ray Crystallography* and describes crystal structures

in terms of *Strukturbericht* types. The conventions employed are carefully systematized and logically chosen, but the reader with only a limited knowledge of space groups may have difficulty extracting all of the crystallographic information contained herein, and will find it necessary to refer to the *International Tables* for full explanations. No diagrams of crystal structures are given. Pictures of at least the common types would have been a boon for most readers.

The leitmotiv of the entire book is, precisely as the title indicates, lattice spacing, and the author is interested in correlating this as widely as possible with all properties of metals and alloys. From a fundamental point of view this is a task which cannot be done with complete success at present, for two reasons: Theories of alloys are still in a rudimentary state and the lattice parameter is only one of a rather large number of properties having about equal basic importance. In drawing the threads together as far as possible, however, Dr. Pearson has created a most admirable and useful compendium of data.

Physics and Philosophy: The Revolution in Modern Science. Vol. 19 of World Perspectives. By Werner Heisenberg. 206 pp. Harper & Brothers Publishers, New York, 1958. \$4.00. *Reviewed by James MacLachlan, Earl Haig Collegiate Institute.*

In answer to critics of the quantum theory, Heisenberg here states that "It cannot be our task to formulate wishes as to how the atomic phenomena should be; our task can only be to understand them." And this book is dedicated to expanding the understanding of intelligent men for this strange, new physics.

It is probably true that we cannot make physicists of our lay friends, but if any one of them wishes to gain a deeper grasp of the implications of modern physics, no better book than this could be found. It will plunge him into the center of the controversies now current and will demonstrate the extent of achievements of the past fifty years. However, Heisenberg never hesitates to specify problems as yet unresolved, making it clear that there is still a lot of physics left to do.

The book's main thesis is the validity and range of applicability of the Copenhagen interpretation of quantum theory. This interpretation is founded on Bohr's principle of complementarity, and on the paradox that while the conditions and results of an atomic experiment are described in classical terms, no description is possible of the "events" between observations. The statistical nature of quantum theory is necessary for the prediction of succeeding observations. It is interesting to see the extension of complementarity beyond quantum theory: for example in daily life, deliberation about a proposed course of action is complementary to the decision to act.

Heisenberg discusses, in turn, the development and present situation of the quantum theory, the relation of quantum concepts to traditional philosophic points of



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view, and to other natural sciences, in particular, biology. He goes on to consider the implications of the theory of relativity for a consistent picture of the universe. He then deals with the criticisms of Einstein, Bohm, and others. Finally he investigates the effects of quantum theory on theories of matter and on the development of language and logic. The book, originally the Gifford Lectures for 1955-56, is wholly a philosophical treatment, at the so-called semipopular level, of the present state of problems of materialism, existence, and reality in the light of modern physics.

Heisenberg makes the well-known statement that classical physics applies for velocities much smaller than the velocity of light, and for actions much larger than Planck's constant. He goes on to suggest the possibility of a third natural dimension to combine with these two constants, a length of the order of 10^{-13} cm. Then classical concepts would apply only for dimensions much larger than this. To reduce the mental difficulties of picturing atomic events, he suggests applying the Aristotelian concept of "potentia". On this basis pictures in our minds would "represent only a tendency toward reality".

So excellent a book could be considerably improved by the inclusion of even a brief index of the terms used, to indicate the depth of their meaning, and the breadth of their applicability. For instance, what is the variety of examples that make vivid the concept of complementarity? It is unfortunate that Heisenberg's text, marked by clarity and conciseness, should be preceded by an unclear editor's introduction and an unconcise philosopher's introduction.

An Introduction to Scale Coordinate Physics: An Introduction to the Formalization of the Macro Operational Point of View. By William Bender. 340 pp. Burgess Publishing Co., Minneapolis, Minn., 1958. \$7.50. *Reviewed by R. Bruce Lindsay, Brown University.*

In this book the author presents what he terms the macro operational point of view in physics. By this he appears to mean the attempt to describe all physical phenomena in terms of quantities immediately measured by laboratory apparatus. He feels that this program can be carried out most effectively by reducing all analytical formulas in physics to nondimensional form. In this process, however, the author retains a special symbol for the dimensional factor and expresses the numeric in the form of the sum of two symbols, one an integer and the other a proper fraction. This has the effect of replacing the single symbol, usually associated with a physical coordinate, with three symbols, or what he refers to as a scale coordinate. The resulting increase in complexity in the writing of the equations of physics is obvious and unfortunately the author does not make clear any compensating gain in clarity or understanding. Most of the book is devoted to a rewriting of physical equations in terms of the new coordinates. There is a good deal of discussion of

physical methodology but it is unsystematic, repetitious, and with little or no reference to the large body of literature now extant on the nature of physical theory and physical concepts. Numerous typographical errors render the reading of the book difficult.

Exterior Ballistics of Rockets. By Leverett Davis, Jr., James W. Follin, Jr., Leon Blitzler. 457 pp. D. Van Nostrand Co., Inc., Princeton, N. J., 1958. \$8.50. *Reviewed by S. F. Singer, University of Maryland.*

This book develops the ballistics during burning and during atmospheric flight of simple rockets, i.e., rockets having no moving surfaces. It thus deals with rockets whose stability depends either on fins or on spin. The volume, therefore, contains no discussion of servo loops, errors in control systems, etc. There is no treatment of rocket propulsion as such (this belongs to interior ballistics) nor of terminal ballistics. Neither is it a textbook of aerodynamics. (In fact references to drag coefficients and similar aerodynamics data seem strangely antiquated.) Therefore, drag coefficients for a given rocket configuration must be obtained from other sources.

The volume had its origin in the Cal Tech OSRD project during World War II when rapid strides were made in the development of small solid-fuel rockets. The accompanying theory was developed as needed and subsequently published as a classified document. The present volume is a declassified version which has been corrected and to which new figures have been added.

The first half deals with fin-stabilized rockets. The forces acting on the rocket system during and after burning are carefully discussed and then the equations of motion derived and solutions obtained. To give an indication of the detail of the treatment there are sections entitled: Effect of a Constant Linear Thrust Misalignment, and as a subsection: Effect of Launcher Length.

The all-important problem throughout is the dispersion of the rocket, i.e., its accuracy. There are many factors responsible for inaccuracies such as bent fins, moving launchers, and high winds at launching. These and others are discussed in detail and their effects evaluated. If all care is taken, the final inaccuracy is still produced by the nonuniform flow of the rocket gas through the nozzle which gives rise to a thrust misalignment. This in turn causes a torque which points the rocket away from the proper direction. Rotation will average out this thrust asymmetry to a certain extent and larger fins are also helpful since they provide a greater aerodynamic restoring moment. Unfortunately, the fins are not very useful in the critical launching phase since the velocity and therefore the aerodynamic forces are very small. (This latter objection does not apply to aircraft-launched rockets since here the rocket already has a high initial velocity, namely that of the airplane.)

For this reason it is often desirable to spin the rocket extremely rapidly and eliminate the fins altogether.